Speed - Force - Torque

Speed versus Velocity

Speed = Distance per unit Time

Common Examples: Miles per Hour, Feet per Second, Kilometers per Hour, Meters per Second

Uncommon Example: Furlongs per Fortnight

Velocity = Speed in a specified direction

Same units as speed but with a direction

Question: Can you change Velocity without changing Speed?
Answer: Yes, Keep the same speed just change direction.

Speed - Force - Torque

Force:

Definitions related to Force:

Acceleration: velocity change per unit time

Common Units: (feet/sec)/sec = ft/sec^2, m/sec^2

Mass: amount of matter

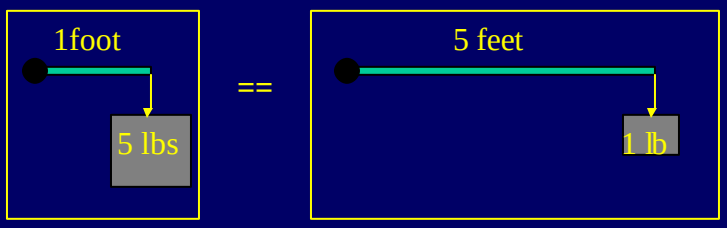
Common Units: Kilograms, pounds(lbm*)

(*lbm = amount of mass weighing 1 lb at normal gravity)

Force = Mass times Acceleration (F=ma)

Speed - Force - Torque

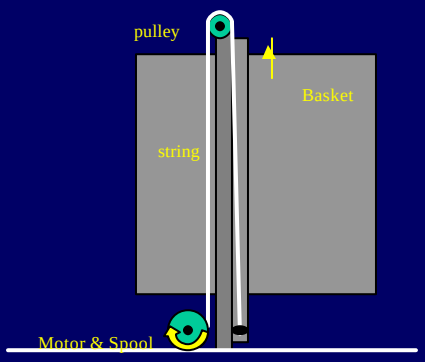
Torque - rotational force
Units: force * distance
Common Units: ft lbs, Newton meters
Example: 5 ft lbs = 1 lb at 5ft = 5 lbs at 1 ft



Speed - Force - Torque

Example from Last Year:

You have a rough design but need to figure out what motor & size spool you need - see diagram.



Problem: What kind of motor do you need to attach to what size spool?

Given: The basket needs to travel up 3 feet vertically in 5 seconds.
The baskets weighs 20 lbs fully loaded with balls

Speed - Force - Torque

Speed Considerations:

Speed of the basket = 3 feet per 5 seconds = 0.6 ft/sec
Spool needs to wind string at 0.6 ft/sec - This can be written as:

0.6 ft/sec = 2 * (radius of spool) * ? * (revs/sec)

Force Considerations:

Force needed to raise the basket at a constant velocity:
Sum of Forces = 0 = weight of basket - force pulling up
(Since velocity is constant, there is no acceleration)
The motor needs to generate 20lbs of force.

Speed - Force - Torque

Since motors are measured in terms of torque, we need to convert from force to torque:

Torque needed = radius of spool * 20 lbs.

Note: An initial force greater than 20lbs is needed to get the basket moving. And unless you can create frictionless pulleys and gears, the force needed will be greater than 20 lbs to maintain the constant velocity upwards.

Speed - Force - Torque

Using the speed equation and the force equation you can now match up the basket system needs with the available motors.